Determining optimal nitrogen rates for dahlia cut-flower production in sandy soils on Long Island, NY

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3/14/24

Dahlias are an important, high demand flower on Long Island. There is not a known optimum nitrogen application rate for dahlias grown in sandy soils in our maritime climate. The objective of this study was to determine the optimum nitrogen application rate for a popular dahlia cultivar, Café au lait, commonly grown for cut-flower production on Long Island. Understanding optimum application rates will help growers produce the highest standard, most profitable flowers. Too much nitrogen can result in overly leafy plants while too little nitrogen may result in decreased growth rate. This trial will aid in minimizing nitrogen pollution, maximizing flower quality, and increasing profit. This will help growers and protect our sensitive Long Island environment.

Methods

On March 20th 2023 90 dahlia tuberous roots were weighed, placed in pots with general purpose growing media and grown in a greenhouse set to 70° F at Long Island Horticultural Research and Extension Center (LIHREC). On May 16th, the dahlias were planted in fields and spaced approximately 18 inches apart, in a zig-zag pattern and fertilized according to their treatment type. This project tested 3 nitrogen (N) treatments on Café au lait dahlias. The first treatment was no added N fertilizer (control). The second was the grower standard of 150 lbs N/acre applied in split applications at planting and in July (150). The third treatment was applying nitrogen at a rate of 50 lbs/acre in July only (50). We used Espoma Organic Plantone 5-3-3 All Purpose Plant Food as fertilizer. Treatments were spaced at least three feet away from each other to prevent effects from other nitrogen treatments. The dahlias were staked with 3 bamboo canes and wrapped with twine, forming a triangle around each plant (Armitage, 2003). This field portion of this project took place at LIHREC in Riverhead, NY and at North Fork Flower Farm (NFFF) in Southold, NY.

Picture 1. Dahlias at LIHREC


Picture 2. Dahlias at NFFF

We conducted complete chemical soil analysis at each site within each treatment subplot just prior to planting. There were 2 sites with 3 nitrogen treatments, totaling 6 soil samples. On July 24-28, approximately a week after the final split application of fertilizer, four foliar samples were collected from each treatment totaling 24 samples. Photosynthetic stress, measured as Fv/Fm and chlorophyll content were measured on June 6, June 27, July 24, and September 19 at LIHREC and NFFF and October 2 at LIHREC. At peak bloom, dahlia blooms were cut and scored for their bloom diameter, bloom circularity, and bloom angle.

Dahlias were harvested on October 11th. Tuberous roots were removed from the soil, rinsed, and left to dry in a ~ 70° F greenhouse for 2-3 hours. Dried tuberous roots were placed in newspaper and stored in a dark, cool, dry location. Harvested aboveground biomass was dried in an oven for 24-48 hours at 110° F and weighed. The results were analyzed in R statistics using ANCOVAs and t-tests where there was only data for one site (R team, 2023).

Results

Soils at NFFF and LIHREC are both haven loam. At NFFF, the control plot contains 3.43% organic matter with a pH of 6.7, the 50 plot contains 3.41% organic matter with a pH of 6.8, and the 150 plot contains 3.76% organic matter with a pH of 6.6. At LIHREC, the control plot contains 5.99% organic matter with a pH of 7.5, the 50 plot contains 5.71% organic matter with a pH of 7.3, and the 150 plot contains 4.56% organic matter with a pH of 7.5. Soil P and K were higher at NFFF but within sufficiency range at both sites.

Dahlias had significantly greater aboveground biomass at LIHREC compared to NFFF. Fertilizer treatment was not correlated with aboveground biomass at either site. Foliar N, P, and K were not correlated with treatment or site. July, October, and September (September only at LIHREC) leaf chlorophyll content and photosynthetic stress were not correlated with sites or N treatments. On June 6th leaf chlorophyll content was greater at LIHREC than NFFF. On June 27th at NFFF, chlorophyll content increased with increased N rate, while leaf chlorophyll content at LIHREC decreased with increased N rate. On June 6th at NFFF there was less photosynthetic stress with increased N, while at LIHREC photosynthetic stress increased with increased N rate.

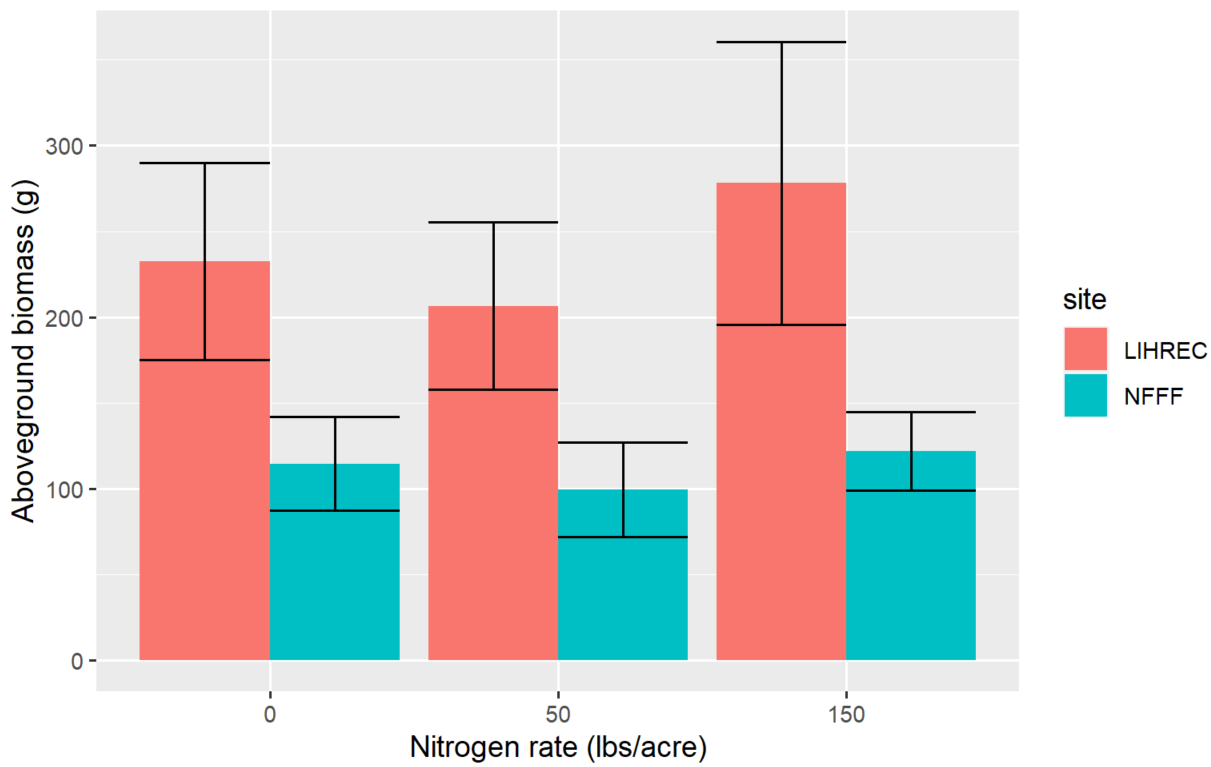

figure 1. Dahlia aboveground biomass (g) and nitrogen rate 0, 50, and 150 lbs/acre at LIHREC and NFFF. Full text description (PDF)

Initial tuberous root weight was not correlated with final harvested tuber weight. Initial tuberous root weight was negatively correlated with aboveground biomass at LIHREC, where larger aboveground biomass was correlated with smaller initial tuberous root weights. At NFFF there was no correlation between initial tuberous root weight and aboveground biomass. Final tuberous root weight was positively correlated with aboveground biomass at both sites, with a stronger correlation at NFFF. Larger dahlias were producing larger tuberous roots at the end of the season.

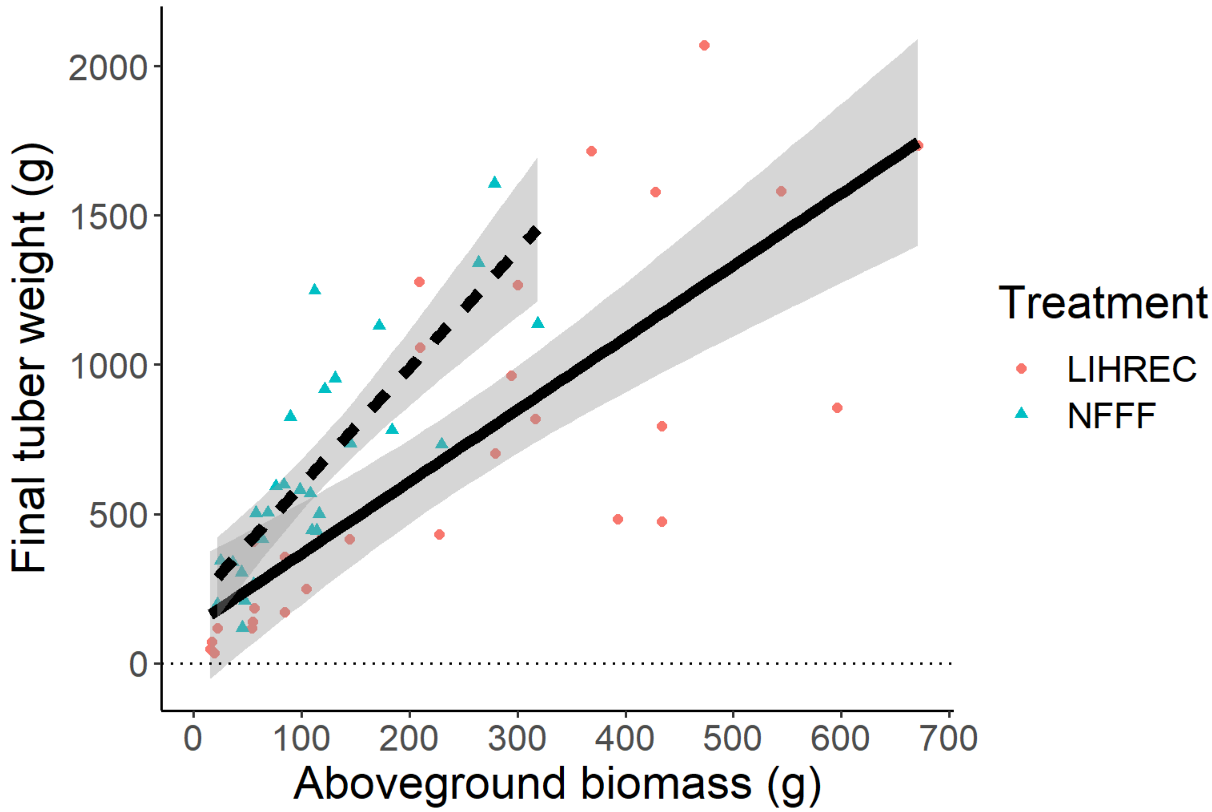

figure 2. Dahlia aboveground biomass (g) and final tuberous root weight (g) at LIHREC (solid line) and NFFF(dashed line). Full text description (PDF).

There were 280 counted blooms at LIHREC and 208 at NFFF. There was a total of 155 blooms in the control plots, 169 in the 50 plots, and 163 in the 150 plots. Blooms were significantly larger in diameter at NFFF compared to LIHREC. At both sites, the largest diameter blooms were from the 50 plots, followed by the control, and the smallest blooms were from the 150 plots. Blooms were more circular at NFFF compared to LIHREC and had bloom angles closer to the desired 90 degrees, N treatment was not correlated with bloom angle or circularity.

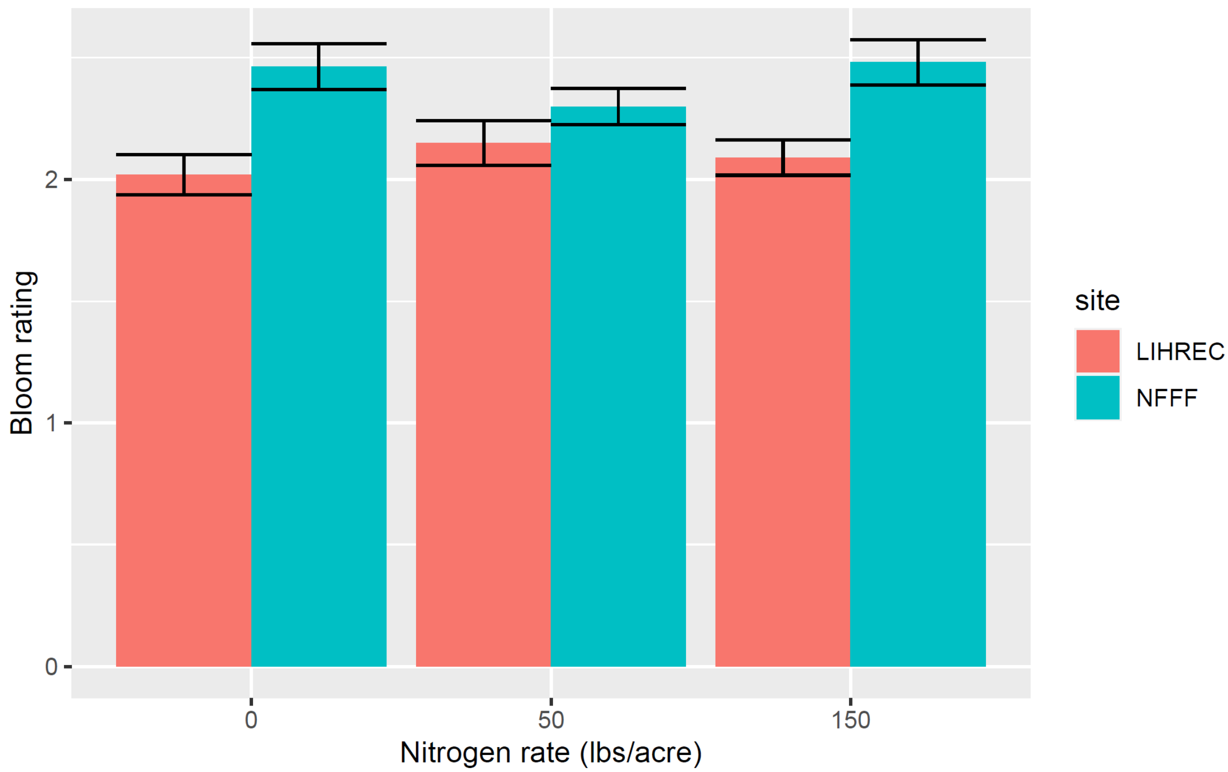

figure 3. Dahlia bloom rating on a scale of 1-3, 3 being the most symmetrical and circular and nitrogen rate 0, 50, and 150 lbs/acre at LIHREC and NFFF.

figure 4. A symmetrical pink café au lait dahlia

Discussion

It is important to note that there was not true replication in this experiment which makes the statistical analysis less robust. The dahlias at both sites suffered from a spring frost, killing some and narrowing our sample size further. Also, the two sites are different due to many factors, and we were unable to add all these factors to our statistical analysis. NFFF is very windy and receives full sunlight while LIHREC is less windy and has some shade during the day from nearby trees. LIHREC was irrigated with overhead irrigation while NFFF was irrigated with drip lines. The goal of this study is to determine if three different nitrogen rates will affect dahlia growth at two different sites, not to necessarily compare dahlia growth at the two sites.

Although the point of the study is not to compare sites, we can hypothesize that the larger aboveground biomass at LIHREC compared to NFFF may be due to higher soil organic matter and its stored nitrogen credit, resulting in overall larger, more leafy plants, regardless of N treatment. At both sites applied nitrogen treatment did not correlate with aboveground biomass or foliar nutrients. At LIHREC, on June 27th an increased N rate was correlated with lower leaf chlorophyll content. The opposite pattern was found at NFFF. The same opposing site pattern was observed for photosynthetic stress on June 6th. The dahlias at LIHREC receiving a greater N rate may be over investing in aboveground biomass at the expense of leaf chlorophyll and photosynthetic stress. The dahlias at NFFF follow the expected trend of higher N rate increasing leaf chlorophyll content and decreasing photosynthetic stress. Why the plants are responding differently at the two sites could be due to many factors. One theory is that the plants at NFFF are more stressed due to the wind and lower soil organic matter and are growing more conservatively, while the plants at LIHREC are growing using a more aggressive strategy as plants in more nutrient rich and favorable environments have been found to do. This theory is supported by dahlias at NFFF having a stronger correlation of aboveground biomass and final tuberous root weight. NFFF dahlias are investing more in their tuberous roots than those at LIHREC, a conservative growth strategy. Without more replication and quantifying abiotic and biotic factors we can not determine why we observed two different growth strategies at the two different sites.

The most important variables to consider are related to the blooms. The largest quantity of blooms and largest sized blooms were collected from the 50 plot. At LIHREC, the site with high organic matter and stored nitrogen credit within the organic matter, the blooms were smaller in diameter and had a lower bloom angle than those at NFFF. This suggests that applying large amounts of nitrogen will not benefit dahlia blooms.

In conclusion, applying 50 lbs/acre N at planting may produce larger blooms in both quantity and size than applying 150 lbs/acre N in a split application or applying no N.

References

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Armitage, Allan and Laushman, Judy, Specialty cut flowers: the production of annuals, perennials, bulbs, and woody plants for fresh and dried cut flowers, 2003, Timber Press I nc.